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Original Paper

Involvement of Remote Monitoring for Ethological Observations of Swines

Ivelina Zapryanova*[1], Teodora Pashova[2]

[1]*Agricultural University, Faculty of Agronomy, Department of Animal Science, Bulgaria*
[2]*Agricultural University, Faculty of Horticulture with Viticulture, Department of Meliorations, Land Regulation and Agrophysics, Bulgaria*

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A behavioural study of Mangalitsa swines was carried out by recording on ethogram forms, as well as remote monitoring by an unmanned aerial vehicle, which allowed to shorten the time between readings. The animals were divided into two age categories, up to 12 months of age, and fattening pigs over 1 year old. The monitoring period covered the months of March, April, and May 2024 from 08:00h to 20:00h. As a result of this first study using a drone of this breed in Bulgaria, it was found that the frequency of eating, rooting and resting was 14.74%, 12.08% and 58.31%, respectively. The measured frequency of eating was 16.9% and 12.6%, and of rooting 14.3% and 9.9%, respectively, in animals up to 12 months of age and the fattened pigs. In both groups, resting frequency was a major part of the day with a difference of 14% between the groups in favour of the older animals.

Keywords: behaviour, drones, free-range, Mangalitsa

1 Introduction

As one of the oldest pig breeds in Europe, the Mangalitsa breed has been undergoing significant changes in the population numbers, driven mainly by a shift in consumer demand and the increasing supply of lean meat. Created about 200 years ago as a result of crossbreeding the Szalonta and Bakony breeds with the Serbian Sumadia pig (Lukač et al., 2016), the Mangalitsa is known for its ability to accumulate large amounts of fat, low fertility, extremely high adaptability to extensive conditions.

The breed came to Bulgaria at the end of the 19th and the beginning of the 20th century after the purchase of breeding animals from Romania, and later from Hungary, and its main territory was Northwestern Bulgaria (Kulska swine), Botevgrad and Plovdiv regions. Mangalitsa swines were bred in the Rila Monastery, Kabiyuk, Kayaburun and Clementina factories (Dermendjieva et al., 2013). After the 1950s, mainly due to the mass introduction of industrial crossbreeding and the change in consumer demand, the Mangalitsa breed, along with the Spotted Derman and the Local clop-eared pig was destroyed as national gene pool.

The diversity of animal production methods and systems offers different conditions for pig farming. While intensive technologies have a high degree of specialisation, automation, and concentration of production, in outdoor pig production the focus falls on welfare and the ability of animals to roam freely, to exhibit their natural behaviour, graze and root whenever they wish (Park et al., 2017). The use of conventional or modern methods for observing animals, birds, etc. is a matter of the adopted research methodology, but the advantages of remote monitoring are incontestable (Yordanov, 2021; Yordanov & Mollov, 2022). In our country, ethological studies have been conducted for pigs, birds, cattle, and horses (Ivanova, 2010; Nikolova, 2002; Popova & Gradev, 2023; Zakhariev et al., 2004), but there are no data on the behaviour of the Mangalitsa breed animals. In connection to this, we set our aim to study the possibility of involvement of remote monitoring for ethological observations of swines.

***Corresponding Author:** Ivelina Zapryanova, Agricultural University, Faculty of Agronomy, Department of Animal Science, 4000, Plovdiv, Mendeleev blvd 12, Bulgaria, ivelina_z@au-plovdiv.bg

2 Material and Methods

The study was conducted on a herd of Mangalitsa swines, on a farm around the village of Banya, Razlog municipality, Bulgaria, during the spring season, including the months of March, April and May 2024. The animals (female and male castrates) were raised outdoors year-round in fenced yards with electric fencing divided into two groups: pigs for fattening from 1 to 3 years of age and breeding pigs up to 12 months of age. Behavioural assessment of the pigs was done on pre-prepared forms-ethograms. Recordings were made every 15 minutes, from 8:00 h to 20:00 h two days in a row, each month. The frequency of occurrence of basic behavioural responses was calculated: eating, drinking, resting, standing, and sitting positions, rooting and different types of interactions with the environment, walking, running, bathing, hierarchical and comfort behaviour, sexual behaviour, playing, urinating and defecating, adhering as much as possible to the characterization of the ethological elements described by Stäbler et al. (2022). Temperature data were also included to the behavioural information, and values were recorded every hour using a mobile app called YR by NRK and the Norwegian Meteorological Institute. The number of animals included in the experiment was 16 for the months of March and April, and 18 in May for the first category under 12 months of age. The herd size of the second category – pigs for fattening from 1 to 3 years of age was 26 in March and April, and 21 in May.

In May, observations of pig behaviour were carried out not only by recording on ethogram-forms, but also by incorporating remote monitoring by a drone, which reduced the time between two readings to 9 minutes. For this purpose, a DJI drone, model Mavic Air, equipped with a 4K Ultra HD camera with 12 MP CMOS sensor and an optical lens with 85° viewing angle was used. The drone has a good real-time picture transmission at a distance from the remote control of up to 80m and a at flight height of up to 50m. In addition, the drone is lightweight, small, and sufficiently manoeuvrable for the purpose of the study. The habitat of the animals involved in the study was a rugged terrain, i.e. 70% of their territory is an open area, but the remaining 30% is occupied by forest vegetation. The weather conditions must be taken into consideration when using the drone – only in dry weather. There are limitations on flight stability from wind power of up to 8 m/s, in open terrain.

The pigs were familiarized with the drone before the actual monitoring began. All groups had a 3-day familiarization period in which the drone was flown over the groups and the observer was positioned a few meters away from the outer wall of the fence. The unmanned device was introduced over the herd initially at 10 m, and then the height was gradually reduced from the point at which the group did not visibly respond to the previous height. Familiarization was considered successful when animals showed no stress response to the drone or the human.

During the first flight, there was anxiety and irritation in the animals, which was strongest in the younger pigs, and which subsided subsequently. On the second day of observation the animals were completely calm and did not react in any way to the presence of the drone, which allowed lowering and hovering from a height of 2 m. During the remainder of the reporting period, all flights were made at a height of 2 m, as it was found that it did not result in any change in the animals' natural behaviour.

The video recordings were reviewed and the frequency of behavioural responses per the specified parameters was recorded by the same team of observers.

The data were processed statistically by multivariate analysis of variance following the following model:

$$Yijkl = \mu + ACi + Mj + TRk + eijkl$$

where: *Yijkl* – observation vector; μ – general average constant; *ACi* – is a fixed effect of the age category ($i = 2$); *Mj* – month ($j = 3$); *TRk* – time of day ($n = 12$); *eijkl* – residual variant

The mathematic analysis was performed with program SPSS v.24.

The study methodology was reviewed and approved by the Experimental Animal Ethics Committee of the Agricultural University – Plovdiv, with permission № 2023-012.

3 Results and Discussion

In the conditions of our study, the average frequency of eating was 14.74%, rooting – 12.08%, with the highest percentage of resting – 58.31%. The frequency of occurrence of other behavioural responses of the entire group is shown in Figure1.

The significance of the studied factors on all the ethological elements is presented in Table 1. Age category had a significant effect on resting, rooting, drinking ($P \leq 0.001$) and eating ($P \leq 0.01$). The time of day was a significant source of variation for resting, eating, and drinking ($P \leq 0.001$), and the month – for lying and rooting ($P \leq 0.01$),walking and playing ($P \leq 0.001$).

Of the three spring months on the days of the study, April was the coldest with 11.5 °C (min 7 °C and max 18 °C) and May was the warmest with an average temperature of 16.3 °C. The highest temperature was measured

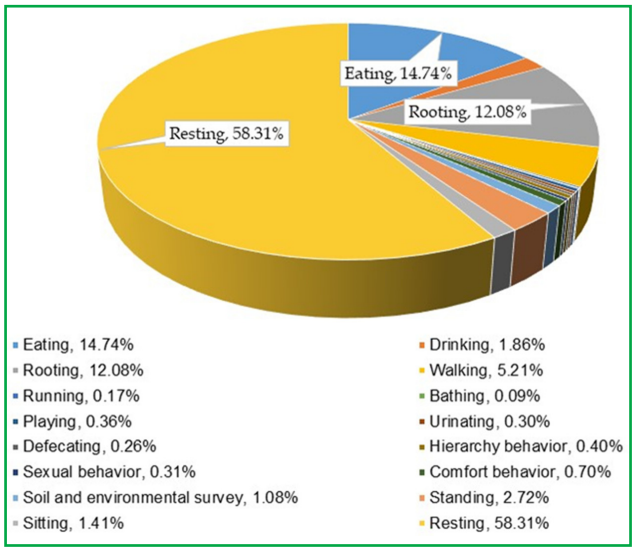

Figure 1 An average frequency of occurrence of all behavioural responses, for both observed groups (%)

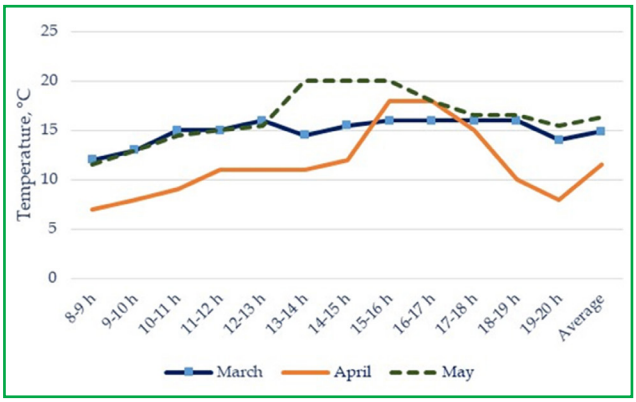

Figure 2 Average temperature values on days of observation

between 13:00h and 16:00h in May (20 °C) and the lowest (7 °C) between 8:00h and 9:00h in April (Figure 2).

The study of animal feeding behaviour is not only of interest to the scientific community, but also to farmers who would be more successful in managing production processes in animal husbandry. In different studies, many parameters of behavioural responses during eating can be monitored – frequency of eating over a period of time, time spent eating, interval between visits to the feeder, etc. (Brown-Brandl et al., 2013).

The feeding of the pigs on the farm was with concentrate feed, which is loaded twice during the day – most often in the morning between 6:30 h and 7:30 h, and in the afternoon – between 16:30 h and 17:30 h.

The unusual activity of pigs in both groups in April and May outside the indicated feed loading range was due to feeding on green matter produced on the farm (Figure

Table 1 The significance of the studied factors on all the ethological elements

Ethological elements/factors	F-criterion and degree of reliability					
	age category		month		time of day	
	F	Sig.	F	Sig.	F	Sig.
Resting	38.188	***	7.192	**	9.380	***
Eating	8.086	**	2.572	–	9.162	***
Rooting	20.766	***	6.207	**	1.766	–
Drinking	34.469	***	2.613	–	3.413	***
Walking	0.158	–	9.218	***	2.774	**
Running	0.167	–	0.106	–	0.628	–
Bathing	0.160	–	4.626	*	1.032	–
Playing	19.312	***	18.229	***	0.692	–
Urinating	4.782	*	5.632	**	0.928	–
Defecating	2.653	–	5.981	**	1.620	–
Hierarchical behaviour	0.164	–	2.717	–	0.931	–
Sexual behaviour	3.971	*	12.679	***	1.140	–
Comfort behaviour	3.002	–	7.733	***	1.169	–
Soil and environmental survey	40.909	***	4.121	*	1.182	–
Standing	0.117	–	16.690	***	2.543	**
Sitting	12.744	***	3.147	*	1.157	–

*P <0.05, **P <0.01, ***P <0.001

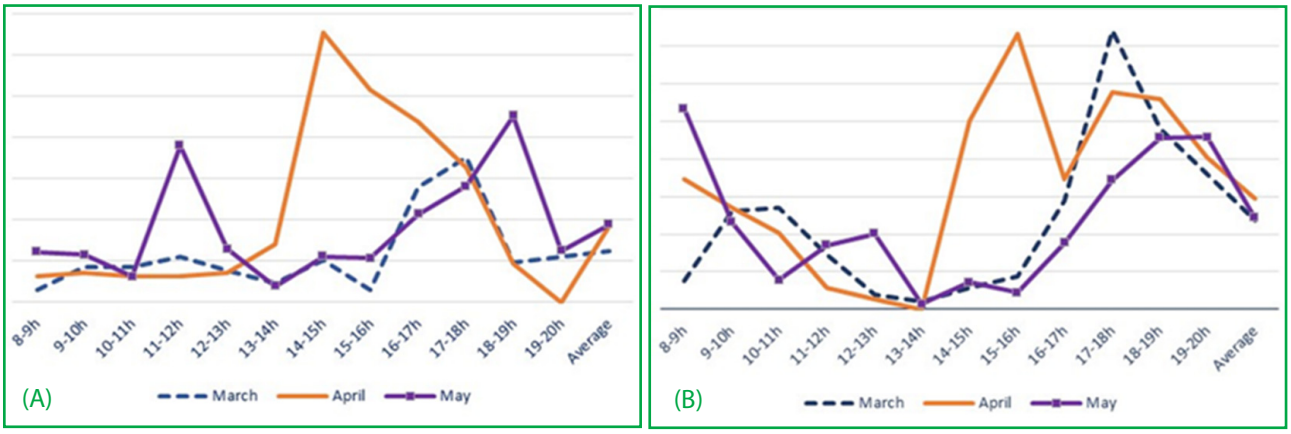

Figure 3 Monthly and hourly dynamics in the frequency of reported acts of eating in pigs up to 12 months of age (A) and in animals for fattening (B) (%)

3). Thus, about 65% of animals from the first, and 37% from the second age category were fed before the usual feeding time with concentrate feed. Age category had a significant effect on feeding frequency, with 16.9% of animals up to 12 months of age and 12.6% of animals in the second category ($P \leq 0.01$). In summary, most fattened animals spent time eating during the month of April (14.7%), and younger animals during the same month and the following month (18.9%). In an experiment conducted with East Balkan breed pigs, Ivanova (2010) reported that animals spent between 13.89% and 44.58% in eating. A relatively low percentage of observed time in eating is mentioned by Stäbler et al. (2022). According to the authors, the experimental animals ate mostly during the day, regardless of the time, while the pigs were less active and ate less frequently during the heat.

The highest average incidence of rooting in one-year-olds was recorded in March and April (16.6%), and in pigs for fattening in April (13.7%). In both age categories, the incidence of this indicator was lowest in May (Figure 4).

The behaviour of the young animals was quite variable in terms of rooting frequency during the first two months of observation. Several peaks of activity were formed in this indicator, with the highest percentage of rooting pigs in the early morning, midday, and early afternoon in April – 31.25%, 34.38% and 26.56% respectively. We could hypothesize that the increased burrowing activity of the animals was due to the fact that the days preceding the farm visit was characterized by constant and heavy rain. According to Olczak et al. (2015), the duration of rummaging is directly related to soil moisture. During the last month of the study, as the time between readings decreased using the drone recordings, the curves of occurrence of exploratory behaviour overlapped to some extent in both groups. We recorded the highest percentage of rooting animals between 15:00 h and 16:00 h (23.93%) for the younger animals, and between 14:00 h and 15:00 h (16.07%) for the fattened pigs. A tendency towards increasing rooting activity during the day was also found by Stäbler et al. (2022).

Figure 4 Monthly and hourly dynamics in the frequency of reported acts of rooting in pigs up to 12 months of age (A) and in fattening pigs (B) (%)

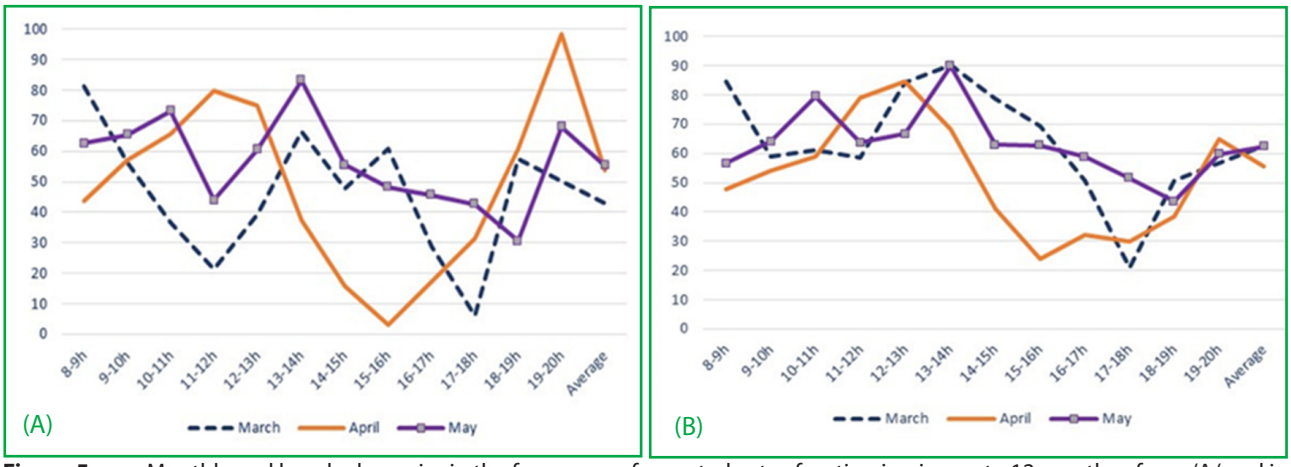

Figure 5 Monthly and hourly dynamics in the frequency of reported acts of resting in pigs up to 12 months of age /A/ and in fattening pigs/B/ (%)

Over the three-month observation period, it was found that pigs spent an average of 58.31% of their time resting, with a 14% difference between groups in favour of fattened animals. The results are in line with those obtained by Martínez-Macipe et al. (2020) in an experiment with Iberian pigs, in which it was found that the animals rested on average 56% of their time, and exploratory behaviours such as foraging, burrowing, licking, etc. were present in 17.8%. According to the authors, when assessing these ethological behaviours, it should be taken into consideration whether the animals are fed concentrate feed as well as their age, pointing out that exploratory behaviour is more common in the younger animals compared to older ones.

In pigs up to 1 year of age, there were more rest breaks, associated with greater activity. Fattened animals were less active and exhibited longer rests compared to pigs up to 12 months of age (Figure 5). The biggest number of resting animals was found in the time window from 13:00h to 14:00h in May, 83% for category A and 90% for category B, with animals calming down and activity decreasing as evening approached. In his study, Stäbler et al. (2022) found almost 47% of total observation time was taken up by resting, explaining this percentage by satisfying the nutritional needs of the pigs ad libitum, so that rummaging is enough to satisfy their behavioural needs, and the rest of the time is used for resting.

4 Conclusions

Over the entire observation period, it was found that the frequency of resting, eating and rooting was 58.31%, 14.74% and 12.08%, respectively. The measured frequency of eating was 16.9% and 12.6%, and of rooting was 14.3% and 9.9%, for animals up to 12 months of age and fattened pigs, respectively. In both groups, rest time was a major part of the day, with a difference of 14% between groups in favour of the fattened ones. Age category had a significant effect on the most common behaviours – resting, rooting, drinking ($P \leq 0.001$) and eating ($P \leq 0.01$). The time of day was a significant source of variation for resting, eating, and drinking ($P \leq 0.001$), and the month – for lying and rooting ($P \leq 0.01$),walking and playing ($P \leq 0.001$). Since this is the first study of its kind with this pig breed in our country, research in this direction should be continued.

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